

**IN THE UNITED STATES PATENT AND TRADEMARK OFFICE  
BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

Application No.:	10/534,110	Confirmation No.:	5161
Applicant:	Flytzani-Stephanopoulos et al.	Filed:	May 6, 2005
Technology Center:	1700		
Art Unit:	1793	Examiner:	Jennifer A. Smith
Docket No.:	3024843 US02	Customer No.:	72,742
TITLE:	CATALYST HAVING METAL IN REDUCED QUANTITY AND REDUCED CLUSTER SIZE		

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Commissioner for Patents  
P.O. Box 1450  
Alexandria, VA 22313-1450

**APPEAL BRIEF PURSUANT TO 37 C.F.R. §41.37**

This is an appeal from the final rejection of the above-identified application dated December 19, 2008. An appropriate Notice of Appeal and the required fee were filed on March 19, 2009. The filing of this communication is considered timely in view of the enclosed Petition for a One Month Extension of Time and authorization to charge the appropriate fees for the extension of time and for filing the Appeal Brief. One copy of this Appeal Brief is being filed (MPEP 1205.02).

In the event that any fees not otherwise paid herewith are due in connection with the submission of this Appeal Brief, Appellant hereby authorizes and specifically requests that such fees be charged to Deposit Account No. 50-3010.

Appeal Brief  
U.S.S.N. 10/534,110  
Inventor: Flitzani-Stephanopoulos et al.

**REAL PARTY IN INTEREST**

The real party in interest is Tufts University, a Massachusetts corporation. The assignment from the inventors to the real party in interest was recorded on May 6, 2005 at Reel 017321, starting at Frame 0364.

Appeal Brief  
U.S.S.N. 10/534,110  
Inventor: Fltzani-Stephanopoulos et al.

**RELATED APPEALS AND INTERFERENCES**

There are no related appeals or interferences.

Appeal Brief  
U.S.S.N. 10/534,110  
Inventor: Fltzani-Stephanopoulos et al.

**STATUS OF THE CLAIMS**

Claims 1-20 stand finally rejected.

Claims 21-44 were withdrawn from consideration due to a restriction requirement.

Claims 1-20 are on appeal.

Appeal Brief  
U.S.S.N. 10/534,110  
Inventor: Fltzani-Stephanopoulos et al.

**STATUS OF THE AMENDMENTS**

No amendments have been filed after the issuance of the Final Office Action.

**SUMMARY OF THE CLAIMED SUBJECT MATTER**

The invention to which independent claim 1 and dependent claims 2-20 are directed is a method of preparing a chemical catalyst supported on a substrate). The method of manufacture of the catalyst is specifically disclosed with respect to systems and methods of the invention at least at paragraphs [0012], [0013], [0055] through [0146], and in Tables I through VII. The supported catalyst is shown in one embodiment in Fig. 16, which is a high resolution transmission electron micrograph of a catalyst prepared according to principles of the invention. The supported catalyst includes a substrate (described at paragraph [0055] at line 2 as a metal oxide), and a second metallic component that comprises metallic crystalline particles and a portion lacking crystallinity (described in paragraph [0055] at lines 2-6). The method of preparing the catalyst material comprises the following steps.

providing a substrate component having a surface (paragraph [0055], line 2;  
paragraph [0057], lines 1-3; paragraph [0063], line 2 );  
producing on said surface of said substrate component a second component having  
metallic crystalline particles and a structure lacking crystallinity (paragraph  
[0055], lines 1-2; paragraph [0057], lines 3-4; paragraph [0063], lines 2-3); and  
removing selectively from said surface of said substrate component at least some of  
said metallic crystalline particles, leaving associated with said substrate  
component at least a portion of said structure lacking crystallinity (paragraph  
[0055], lines 2-6; paragraph [0057], lines 5-6; paragraph [0063], lines 3-5);

whereby said remaining structure lacking crystallinity associated with said substrate component exhibits catalytic activity. (paragraph [0055], lines 10-11; paragraph [0058], lines 2-4; paragraph [0064], lines 3-4).

Dependent claim 2 depends from claim 1 and includes as a further limitation that “said catalytic activity of said remaining structure lacking crystallinity and said substrate component is substantially equal to a catalytic activity exhibited by said catalyst material prior to said selective removal of crystalline particles.” (paragraph 13, lines 1-3; paragraph 55, lines 8-13).

Dependent claim 3 depends from claim 1 and includes as a further limitation that “the step of providing said substrate component comprises forming said substrate by a gelation/coprecipitation process followed by calcining.” (paragraph 99, lines 1-3).

Dependent claim 4 depends from claim 1 and includes as a further limitation that “the step of producing on said surface of said substrate component a metallic component comprises applying said metallic component by a process selected from precipitation, co-precipitation, gelation, evaporation, a deposition-precipitation process, an impregnation process, adsorption of molecules followed by decomposition, ion implantation, chemical vapor deposition, and physical vapor deposition.” (paragraph 63, lines 5-7; paragraph 13, lines 5-10).

Dependent claim 5 depends from claim 1 and includes as a further limitation that “said substrate component comprises a microcrystalline substance.” (paragraph 13, lines 10-11).

Dependent claim 6 depends from claim 1 and includes as a further limitation that “said substrate component is sintered at a temperature of approximately 400 degrees Centigrade.” (paragraph 66, lines 7-8; Fig. 24; paragraph 140, lines 1-4).

Dependent claim 7 depends from claim 1 and includes as a further limitation that “said substrate component comprises a selected one of a rare-earth-, an alkaline earth-, a Sc- or a Y-doped cerium oxide.” (paragraph 108, lines 12-15).

Dependent claim 8 depends from claim 7 and includes as a further limitation that “said rare-earth is lanthanum.” (paragraph 108, lines 4-5; Fig.12).

Dependent claim 9 depends from claim 1 and includes as a further limitation that “said metallic component comprises an element selected from the group consisting of Au, Pt, Cu, Rh, Pd, Ag, Fe, Mn, Ni, Co, Ru, and Ir.” (paragraph 13, lines 14-15; paragraph 57, lines 6-7).

Dependent claim 10 depends from claim 1 and includes as a further limitation that “said removal step comprises a process selected from the group consisting of leaching, etching, and dissolving.” (paragraph 13, lines 15-17).

Dependent claim 11 depends from claim 1 and includes as a further limitation that “said removal step comprises leaching with a solution of NaCN.” (paragraph 70, lines 1-2).

Dependent claim 12 depends from claim 11 and includes as a further limitation that “said removal step comprises leaching with an aqueous solution of 2 mole percent NaCN having a pH of at least 8.” (paragraph 68, lines 1-3).

Dependent claim 13 depends from claim 1 and includes as a further limitation that “said removal step removes at least 10% of the original quantity of said metallic component” (paragraph 58, lines 5-7).

Dependent claim 14 depends from claim 1 and includes as a further limitation that “said removal step removes at least 25% of the original quantity of said metallic component.” (paragraph 58, lines 5-7).



Dependent claim 15 depends from claim 1 and includes as a further limitation that “said removal step removes at least 50% of the original quantity of said metallic component.” (paragraph 58, lines 5-7).

Dependent claim 16 depends from claim 1 and includes as a further limitation that “said removal step removes at least 90% of the original quantity of said metallic component.” (paragraph 58, lines 5-7).

Dependent claim 17 depends from claim 1 and includes as a further limitation that “said catalytic activity is exhibited in the performance of a water gas shift reaction.” (paragraph 76, lines 1-2).

Dependent claim 18 depends from claim 1 and includes as a further limitation that “said substrate comprises an oxide.” (paragraph 55, lines 1-4; paragraph 57, lines 1-6; Fig. 14).

Dependent claim 19 depends from claim 1 and includes as a further limitation that “said substrate comprises a selected one of a zeolite, a carbide, a nitride, a sulfate, and a sulfide.” (paragraph 55, lines 13-14).

Dependent claim 20 depends from claim 1 and includes as a further limitation that “said substrate comprises a crystalline defect solid that provides oxygen to a reaction.” (paragraph 57, lines 1-6; see also paragraph 61, lines 1-3).

**GROUND OF REJECTION TO BE REVIEWED ON APPEAL**

Claims 1-18 and 20 stand rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over the combination of Liu and Flytzani-Stephanopoulos, Total oxidation of carbon monoxide and methane over transition metal-fluorite oxide composite catalysts, J. Catal. 153 (1995) 304-332 (hereinafter “Reference D2”) in view of Bartlett et al., Solution Mining, 2<sup>nd</sup> Edition, Gordon and Breach Science Publishers, (1998) pages 17-18, 20-22, 39 (hereinafter “Reference D3”).

Claim 19 stands rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over the combination of Reference D2 and Reference D3, and further in view of U.S. Patent No. 6,723,298 issued April 20, 2004 to Baumann (hereinafter “Reference D4”).

In the Office Action mailed on December 19, 2008 (hereinafter “the second Office Action”), claims 1-18 and 20 were identified as being rejected over References D2 and D3, and also over References D2, D3 and D4 (and claim 19 was never specifically addressed), whereas in the Office Action dated April 28, 2008 (hereinafter “the first Office Action”), claim 19 was rejected over References D2, D3 and D4. Applicants therefore believe that the second §103(a) rejection was intended to be directed to claim 19, and will argue that rejection as relating to claim 19.

## ARGUMENT

### **I. Introduction**

The present invention is directed to a method of preparing a catalyst material. The disclosure further describes the use of such catalyst material, and describes the catalyst material itself. Only the claims directed to the method of preparing the catalyst material are presently pending.

The Specification describes the preparative methods, at least at paragraphs 66-72. The Specification provides a general explanation and motivation for the invention at paragraphs 55-65. The Specification describes the characterization and use of the catalysts at paragraphs 73-146.

At paragraph [0055] the application recites in relevant part:

In general terms, the disclosure describes **catalysts having active metallic constituents deposited on metal oxide substrates, and subsequently chemically treated to remove therefrom significant amounts of the metallic constituent, including substantially all of the crystalline deposited metal.** Deposited active metal remains on or in the substrate in a form or forms that are smaller in size than one nanometer. **In one embodiment, the metallic constituent is a structure lacking crystallinity.** It is thought that the structure lacking crystallinity contains so few atoms that a crystalline structure electronic metallic character is not observed. The catalysts have been discovered to operate with undiminished efficiency as compared to the deposited metallic constituent that includes nanocrystalline metallic particles on the same substrates. The removal of the majority of the metallic constituent, in some cases as much as 90% thereof, does not compromise the catalytic nature of the material, while providing substantial reductions in cost, especially when the metallic constituent comprises gold, platinum, or other precious metals. In some embodiments, the substrate is a zeolite, carbide, nitride, sulfate, or sulfide. (emphasis added)

At paragraph [0057] the application recites in relevant part:

**The methods involve the production of a highly defective surface on an oxide (e.g. common catalyst supports such as ceria, titania, alumina, magnesia, iron oxide, zinc oxide, and zirconia) and the incorporation of atomically**

**dispersed metals** (as ions, neutral atoms, or clusters of atoms too small to exhibit metallic character) **on or in such a surface, followed by removal of significant amounts of the metal that is deposited in nanocrystalline form.** The removed metal part is recovered in the process. ... (emphasis added)

Such a method, as described and claimed in the present application, is neither taught nor suggested by the prior art references cited by the Examiner, whether such references are considered alone or in combination. In particular, and as discussed below, the Examiner's Grounds for Rejection are inappropriate by virtue of being based on impermissible hindsight, a failure to identify a motivation to combine cited references, and/or a failure to demonstrate that the cited references teach or suggest all of the claim limitations.

In particular, the Examiner has failed to show any reference or combination of references that, individually or together, teaches or suggests the following steps of claim 1 (with emphasis added):

producing on said surface of said substrate component **a second component having metallic crystalline particles and a structure lacking crystallinity;** and **removing selectively from said surface of said substrate component at least some of said metallic crystalline particles, leaving associated with said substrate component at least a portion of said structure lacking crystallinity;**

## II. KSR Analysis

In *KSR International Co. v. Teleflex Inc.*, 127 S.Ct. 1727, 167 L.Ed.2d 705, 82 U.S.P.Q.2d 1385 (2007), the Supreme Court of the United States reaffirmed *Graham v. John Deere Co. of Kansas City*, 383 U.S. 1, 86 S.Ct. 684, 15 L.Ed.2d 545 (1966) but rejected the rigid application of the Teaching-Suggestion-Motivation ("TSM") test. The KSR Court expressed the following principles of law as regards obviousness, in which citations are omitted.

In *Graham*, the Court set out a framework for applying the statutory language of §103, language itself based on the logic of the earlier decision in *Hotchkiss v. Greenwood* and its progeny. See 383 U.S., at 15-17, 86 S.Ct. 684. The analysis is objective:

“Under § 103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved. Against this background the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., might be utilized to give light to the circumstances surrounding the origin of the subject matter sought to be patented.” *Id.*, at 17-18, 86 S.Ct. 684.

While the sequence of these questions might be reordered in any particular case, the factors continue to define the inquiry that controls. If a court, or patent examiner, conducts this analysis and concludes the claimed subject matter was obvious, the claim is invalid under §103.

*KSR* at 1734.

... The combination of familiar elements according to known methods is likely to be obvious when it does no more than yield predictable results.

*KSR* at 1739.

In *United States v. Adams*, 383 U.S. 39, 40, 86 S.Ct. 708, 15 L.Ed.2d 572 (1966), a companion case to *Graham*, the Court considered the obviousness of a “wet battery” that varied from prior designs in two ways ... The Court relied upon the corollary principle that when the prior art teaches away from combining certain known elements, discovery of a successful means of combining them is more likely to be nonobvious.

*KSR* at 1739-1740.

Finally, in *Sakraida v. Ag Pro, Inc.*, 425 U.S. 273, 96 S.Ct. 1532, 47 L.Ed.2d 784 (1976), the Court derived from the precedents the conclusion that when a patent “simply arranges old elements with each performing the same function it had been known to perform” and yields no more than one would expect from such an arrangement, the combination is obvious. *Id.*, at 282, 96 S.Ct. 1532.

*KSR* at 1740.

When a work is available in one field of endeavor, design incentives and other market forces can prompt variations of it, either in the same field or a different one. If a person of ordinary skill can implement a predictable variation, §103 likely bars its patentability.

*KSR* at 1740.

Following these principles may be more difficult in other cases than it is here because the claimed subject matter may involve more than the simple substitution of one known element for another or the mere application of a known technique to a piece of prior art ready for the improvement. ... To facilitate review, this analysis should be made explicit. See *In re Kahn*, 441 F.3d 977, 988 (C.A.Fed.2006) (“[R]ejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness”). As our precedents make clear, however, the analysis need not seek out precise teachings directed to the specific subject matter of the challenged claim, for a court can take account of the inferences and creative steps that a person of ordinary skill in the art would employ.

*KSR* at 1740-1741.

As is clear from cases such as *Adams*, a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.

*KSR* at 1741.

The *Adams* case makes at least two points that have relevance here. One is that **when the prior art teaches away from combining certain known elements**, discovery of a successful means of combining them is more likely to be nonobvious. Another is that **a patent composed of several elements is not proved obvious merely by demonstrating that each of its elements was, independently, known in the prior art.**

The *KSR* Court explicitly instructed that “[i]f a person of ordinary skill can implement a **predictable** variation, §103 likely bars its patentability.” Determining predictability is a required element of the analysis. In the absence of predictability the analysis would be expected to yield a

conclusion of non-obviousness.

In addition, the KSR Court accepts that “[t]o facilitate review, this analysis should be made explicit.” It quotes the Kahn Court to the effect that “rejections on obviousness grounds cannot be sustained by mere conclusory statements; instead, **there must be some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness.**”

### **III. Argument Against 35 U.S.C. §103(a) Rejection of Claims 1-18 and 20 Based on the Combination of Reference D2 in View of Reference D3**

Claims 1-18 and 20 stand rejected pursuant to 35 U.S.C. §103(a) as being unpatentable over the combination of Reference D2 in view of Reference D3.

Claim 1 recites:

A method of preparing a catalyst material, comprising the steps of:

providing a substrate component having a surface;

producing on said surface of said substrate component a second component having

metallic crystalline particles and a structure lacking crystallinity; and

removing selectively from said surface of said substrate component at least some of

said metallic crystalline particles, leaving associated with said substrate

component at least a portion of said structure lacking crystallinity;

whereby said remaining structure lacking crystallinity associated with said substrate

component exhibits catalytic activity.

Applicants respectfully point out that Applicants are the authors of Reference D2, and so should have some understanding of what it describes.

Even under KSR, the Examiner has a burden of presenting some articulated reasoning with some rational underpinning to combine the teachings of two or more references, which must be found independent from (or without reliance on) the teachings of the application being examined.

In the first Office Action (and reiterated in the second Office Action) the Examiner argued with regard to claims 1 and 2, that Reference D2 teaches “[a] lanthanum-cerium nanocrystalline support is provided. Gold nanoparticles (crystalline structure) are deposited on the support. **The total structure lacks a shared crystalline structure.**” (emphasis added)

**A. Reference D2 does not teach or suggest producing the “structure lacking crystallinity.”**

Applicants previously responded, and now respectfully reiterate, that the support taught by Reference D2 is in fact a lanthanum-doped cerium oxide support. Applicants respectfully submit that the lanthanum-doped cerium oxide is an oxide that is substantially an insulator and is not metallic in its conductive behavior. Applicants previously conceded that Reference D2 teaches a substrate component having a surface. Therefore, the lanthanum-cerium oxide of Reference D2 teaches the first step of claim 1, namely:

providing a substrate component having a surface;

However, the second step recited in claim 1 requires (emphasis added):



producing on said surface of said substrate component **a second component having metallic crystalline particles and a structure lacking crystallinity;**

The claim language requires a second component that is provided on the surface of the substrate and therefore does not include the substrate itself. The Examiner does not have the luxury of asserting that the crystalline lanthanum-doped cerium oxide substrate component is both the substrate having a surface and also a part of the second component as recited in the claim.

There is no evidence presented in D2 that the gold nanoparticles deposited on the lanthanum-cerium nanocrystalline support comprise **a second component having metallic crystalline particles and a structure lacking crystallinity** as is required by the plain language of claim 1.

### **Claim Construction**

The basis for claim construction is discussed in the MPEP at §2164.08, which makes clear that the enabled scope of a claim has to be considered in terms of what the inventor described.

#### **MPEP §2164.08**

When analyzing **the enabled scope** of a claim, the teachings of the specification must not be ignored because **claims are to be given their broadest reasonable interpretation that is consistent with the specification.** (emphasis added)

It is clear from the description at paragraph [0143] through paragraph [0145] that the invention contemplates a catalyst material comprising a support (such as a defect oxide) and a material lacking crystallinity as being catalytically active:

... Removal of gold by leaching from Au-ceria in which the ceria was pre-calcined at 800 °C was essentially complete. It appears that large- sized ceria particles do not retain gold after leaching. On the other hand, defective oxide surfaces having defects above a specific density permit the removal of the gold particles while maintaining catalytic activity.

...  
Fig. 26 and Fig. 27 taken together strongly suggest that the presence of gold having a structure lacking crystallinity in association with a defect oxide is effective in providing catalytic activity.

The Examiner cannot ignore a claimed feature of the invention (the structure lacking crystallinity). The argument by the Examiner that “[t]he total structure [of Reference D2] lacks a shared crystalline structure” is wide of the mark, because the cited clause requires that the second component on the surface of the support have two parts, namely, first, metallic particles, and second, a structure lacking crystallinity. This is not the same as two crystalline substances that do not share a single crystal structure. The gold nanoparticles satisfy only one part (metallic particles) of the material produced in the second step. There is no disclosure in Reference D2 that teaches or suggests the presence of a structure lacking crystallinity. The crystalline lanthanum-doped cerium oxide substrate of Reference D2 is also not the structure lacking crystallinity. At the time Reference D2 was published (1995), it was not contemplated by anyone that a structure lacking crystallinity would provide the catalytic activity discovered by the inventors.

Applicants therefore argue in the first instance that because the description of Reference D2 does not describe “a second component having metallic crystalline particles and a structure lacking crystallinity” it is not a sufficient reference to anticipate or to make obvious the second step recited in claim 1. The argument presented by the Examiner as regards claim 1 is therefore

deficient on its face, because there is no teaching or suggestion in D2 of the presence of a structure lacking crystallinity, even if it does teach the presence of gold nanoparticles.

**B. Reference D2 fails to teach the step of “removing selectively from said surface of said substrate component at least some of said metallic crystalline particles, leaving associated with said substrate component at least a portion of said structure lacking crystallinity.”**

The ability to retain the catalytic behavior of the catalyst material after the crystalline metallic particles are removed is an unexpected result. Therefore, the step of “removing selectively from said surface of said substrate component at least some of said metallic crystalline particles, leaving associated with said substrate component at least a portion of said structure lacking crystallinity” so that catalytic activity remains after the removal is not a predictable result that would readily be attained based on known etching or dissolution of catalyst materials such as gold.

Even if one were to argue that the presence of both the metallic crystalline particles and the structure lacking crystallinity were provided in some inherent manner (which is not conceded by Applicants), there is no teaching or suggestion in Reference D2 that one can or should perform the third step as recited in claim 1 (emphasis added):

**removing selectively from said surface of said substrate component at least some of said metallic crystalline particles, leaving associated with said substrate component at least a portion of said structure lacking crystallinity;**

Applicants respectfully submit that Reference D2 does not teach or suggest removing metallic crystalline particles from the catalyst material as a step in manufacturing the catalyst. It is admitted at page 5 in the first Office action that Reference “D1 [*sic*] fails to teach removing some of the metallic crystalline particles from the surface.” Given that the rejection of claim 1 was based on Reference D2 and Reference D3, and that Reference D1 was not being cited, Applicants believe that the Examiner meant that Reference D2 fails to teach removing some of the metallic particles from the surface.

**C. Reference D3 fails to teach the step of “removing selectively from said surface of said substrate component at least some of said metallic crystalline particles, leaving associated with said substrate component at least a portion of said structure lacking crystallinity.”**

The Examiner cites Reference D3, specifically pages 17-18 and 20-21, for the premise that “Bartlett et al. (D3, hereafter) teaches removal of gold via cyanide leach solutions.” The Examiner cites Reference D3 to support the proposition that it would be obvious “to remove the gold metallic crystalline particles of the catalyst taught in D2 via a leaching method taught in D3 because in this way, a portion of the gold particles could be recovered and reused in a similar catalyst production process.” This argument overlooks the requirement of the third step of claim 1 relating to the **selective** removal of at least some of the metallic crystalline particles, while leaving at least a portion of the structure lacking crystallinity associated with the substrate component. This argument also overlooks the requirement that “said remaining structure lacking

crystallinity associated with said substrate component exhibits catalytic activity.” If the argument that the Examiner is making is that cyanide solutions are known to dissolve gold, that is neither the novel feature of the invention nor is cyanide solution even a required element in claim 1.

The Examiner has provided selected pages from Reference D3. Applicants append hereto preface pages *xxiii* and *xxiv*, pages 1 through 35 of Reference D3, as well as the title page and the page bearing the copyright with the date (1998) of the second edition.

Reference D3 at Preface page *xxiii*, first paragraph, lines 2-6, recites that the book was derived from a “course ... initiated to provide an introduction to the rapidly expanding field of solution mining, particularly for the extraction of gold, silver and copper. The annual economic value of solution mined metals in the United States now exceeds that of metals extracted by underground mining.” At page *xxiv*, first paragraph, lines 3-4, the book recites that “heap leaching gold ore has become a billion-dollar industry in Nevada.” At page *xxiv*, third paragraph, lines 3-6, the book recites that “Recently, I have been interested in biooxidative pretreatment of low-grade refractory gold ores in bacteria inoculated wet stockpiles, prior to cyanide leaching.” Plainly, when extracting precious metals from ore, the intention is to remove every atom possible, so long as the cost is reasonable (e.g., less than the value of the metal extracted).

It is clear that Reference D3 teaches solution mining methods, in which the intention is to extract metals having economic value from ores. At page 5, first full paragraph, lines 3-4, Reference D3 teaches that “Although oxygen is required to solubilize gold in cyanide leaching, the amount is small.” At page 6, full paragraph, last three lines, Reference D3 teaches that

“Many low grade gold mines, opened in the last decade and operating profitably, would not be possible without the low-cost leaching of ore in heaps.” No precious metal is intended to be left behind. At page 19, last four lines of text, Reference D3 teaches that “residual oxygen in the air within a heap, assuming 20 vol pct air void space after solution soaking, is at least two orders of magnitude greater than the amount of oxygen required to dissolve all of the gold typically present in heap leached gold ores.” Dissolution of metallic gold in cyanide solution containing oxygen is well known, and is described for mining purposes by Reference D3, at equation 2.1. There does not appear to be a discussion of any kind of reaction such as the water gas shift reaction or of the oxidation of carbon monoxide or of hydrocarbons such as methane in Reference D3.

Reference D3 appears to teach away from the use of cyanide leaching for gold particles. At page 18, third paragraph, lines 1-3, Reference D3 teaches that “[h]eap leaching is not useful for all gold ore deposits. Gold particles are dissolved very slowly and heap leaching does not work well on placer deposits because the gold grains are too large.”

In particular, Reference D3 describes the heap leaching of ores containing gold (Au) for lengthy periods of up to weeks for the specific purpose of removing as much of the gold as possible. At page 23, first paragraph, Reference D3 teaches that “Figures 2.2 and 2.3 indicate that for reasonably porous ore crushed to ~20 mm, most of the gold will be extracted in one or two weeks of heap leaching.” (*see* Figure 2.2 – period of up to 8 days, *see* Figure 2.3 – period of up to 4 weeks, and *see* Figure 2.4 – period up to 100 weeks)

Therefore, it is not seen how the disclosure of Reference D3 remedies the various shortcomings of Reference D2 and/or the Examiner's improper analysis thereof. Reference D3 likewise fails to teach or suggest a method of preparing a catalyst material, as recited in claim 1.

There is no explanation or articulated reasoning with some rational underpinning why anyone would seek to combine a description of the total removal of gold using cyanide solution as taught in Reference D3 with the discussion of catalysts for the total oxidation of carbon monoxide or total oxidation of hydrocarbons as taught in Reference D2.

The only apparent basis for trying to make such a combination is the disclosure of the Applicants itself, which is an impermissible basis for making such a combination (“impermissible hindsight”). Certainly there is no basis for such a combination that appears in either Reference D2 or Reference D3. About the only thing the two references have in common is that they mention gold.

Applicants respectfully submit that the combination of Reference D2 and Reference D3 is not supported by any explanation or articulated reasoning with some rational underpinning, and therefore, that the combination of Reference D2 and Reference D3 is inappropriate.

*Arguendo*, Applicants further respectfully submit that even if such a combination were supported by some argument or reasoning, that the combination still fails to teach or suggest the step of “producing on said surface of said substrate component a second component having metallic crystalline particles and a structure lacking crystallinity.” Accordingly, Applicants respectfully submit that claim 1 is patentable over the combination of Reference D2 and Reference D3 (assuming that such a combination is appropriate, which Applicants do not

concede) and that there has not been given a *prima facie* rejection, because at least one step of claim 1 is not taught or suggested by either reference, alone or in combination.

Claims 2-18 and 20 all depend, directly or indirectly from claim 1. "A claim in dependent form shall be construed to incorporate by reference all the limitations of the claim to which it refers." (35 U.S.C. §112, 4<sup>th</sup> paragraph) Under the operation of 35 U.S.C. §112, 4<sup>th</sup> paragraph, each of dependent claims 2-18 and 20 includes the second and third steps recited in claim 1. To the extent that claim 1 is not rendered obvious and unpatentable over the combination of Reference D2 and Reference D3, neither is any of claims 2-18 and 20.

#### **IV. Argument Against 35 U.S.C. §103(a) Rejection of Claim 19 Based on the Combination of Reference D2 in View of Reference D3 and Further in View of Reference D4.**

Claim 19 includes all of the claim elements of claim 1 from which it depends, and adds the further limitation "said substrate comprises a selected one of a zeolite, a carbide, a nitride, a sulfate, and a sulfide."

The Examiner cited Reference D4 because it teaches a substrate support that can be made from a zeolite.

**A. The combination of References D2, D3 and D4 fails to teach the step of "producing on said surface of said substrate component a second component having metallic crystalline particles and a structure lacking crystallinity" and fails to teach the step of "removing selectively from said surface of said substrate component at least some of**



**said metallic crystalline particles, leaving associated with said substrate component at least a portion of said structure lacking crystallinity.”**

Reference D4 fails to teach or suggest the step of claim 1 that recites “producing on said surface of said substrate component a second component having metallic crystalline particles and a structure lacking crystallinity.”

Reference D4 fails to teach or suggest the step of claim 1 that recites “removing selectively from said surface of said substrate component at least some of said metallic crystalline particles, leaving associated with said substrate component at least a portion of said structure lacking crystallinity.”

Reference D4 does not teach or suggest any form of removal of material, for example by leaching, etching or dissolution, from the catalyst surface. An electronic search of the text of Reference D4 as available on the USPTO web site fails to disclose any usage of the terms “leach,” “etch” or “dissolve” in any of their variants other than a single reference at column 5, lines 63-66, as follows:

... The **dissolved** components of the suspension are then precipitated onto the suspended support material through the addition of a basic precipitation agent such as sodium hydroxide. ... (emphasis added)

Applicants respectfully submit that Reference D4 fails to teach or suggest any form of removal of material, for example by etching or dissolution, from the catalyst surface.

By the analysis presented hereinabove regarding the failure of Reference D2 and Reference D3 to teach or suggest the steps enumerated immediately above, and because 35 U.S.C. §112, 4<sup>th</sup> paragraph requires that all of the limitations of claim 1 are present in claim 19, the failure to teach or suggest the steps is not cured even with the combination of Reference D4 with Reference D2 and D3. Accordingly, one grounds for overturning the rejection of claim 19

is that the steps of claim 1 that are present in claim 19 are not rendered unpatentable even over the combination of all of References D2, D3 and D4.

**B. There is no motivation to make the combination of References D2, D3 and D4.**

Reference D4 teaches catalysts useful for the water gas shift reaction. *See* Reference D4 at column 1, lines 25-28. As previously discussed, Reference D2 teaches catalysts useful for oxidation of CO or hydrocarbons. As previously discussed, Reference D3 teaches methods of solution mining for gold.

Reference D4 teaches, at column 2, lines 1-12, that catalysts used for the water gas shift reaction can be deactivated or damaged under certain operating conditions, and that catalysts used under inappropriate operating conditions may provide insufficient activity or may catalyze unwanted reactions:

The described two stage conduct of the process is necessary because of the properties of these catalysts. While Cu/ZnO-containing catalysts become deactivated above 270 °C. because of recrystallization, or sintering, of the copper, the Fe/Cr-containing catalysts that are used in the high temperature range cannot be used at low temperatures because of insufficient activity. If the indicated temperature range of the high temperature catalysts is exceeded, methanation reactions (reaction equations (2) and (3)) can occur, which reduce the selectivity of the high temperature catalyst and because of this lower the overall efficiency of the hydrogen generation system.

The water gas shift reaction is one in which CO (carbon monoxide) and water react to produce hydrogen and CO<sub>2</sub> (carbon dioxide) as shown in equation (1) of Reference D4 and paragraph [0005] of the present application as published (Patent Application Publication No. US 2006/0128565 A1). In the water gas shift reaction, the oxygen necessary to convert carbon monoxide to carbon dioxide is provided by the water. One of the purposes of conducting the

water gas shift reaction is to provide hydrogen as a substance to be consumed in fuel cells.

Another purpose of conducting the water gas shift reaction is to remove carbon monoxide from a gas stream because carbon monoxide can poison certain catalytic materials.

The only apparent basis for trying to make a combination of Reference D2, Reference D3, and Reference D4 is the disclosure of the Applicants itself, which is an impermissible basis for making such a combination (“impermissible hindsight”). Certainly there is no basis for such a combination that appears in any of Reference D2, Reference D3, and Reference D4. Applicants respectfully submit that the combination of Reference D2, Reference D3, and Reference D4 is not supported by any explanation or articulated reasoning with some rational underpinning, and therefore, that the combination of Reference D2, Reference D3, and Reference D4 is inappropriate.

Accordingly, Applicants respectfully submit that the rejection of claim 19 on the basis of a combination of Reference D2, Reference D3, and Reference D4 is a facially insufficient rejection, and should be overturned.

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**V. Conclusion**

The inventions recited in claims 1-20 are neither taught nor suggested by the prior art cited by the Examiner. For the reasons presented hereinabove, the Examiner's Grounds for Rejection of these claims pursuant to 35 U.S.C. §103(a) are wholly inappropriate by virtue of being based on impermissible hindsight, a failure to identify a motivation to combine cited references, and/or a failure to demonstrate that the cited references teach or suggest all of the claim limitations. Thus, a favorable decision reversing the Examiner's rejections of claims 1-20 is respectfully requested.

Respectfully submitted,  
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Date: April 17, 2009

JBM/

**CLAIMS APPENDIX**

1. (Original) A method of preparing a catalyst material, comprising the steps of:  
providing a substrate component having a surface;  
producing on said surface of said substrate component a second component having  
metallic crystalline particles and a structure lacking crystallinity; and  
removing selectively from said surface of said substrate component at least some of  
said metallic crystalline particles, leaving associated with said substrate  
component at least a portion of said structure lacking crystallinity;  
whereby said remaining structure lacking crystallinity associated with said substrate  
component exhibits catalytic activity.
2. (Original) The method of claim 1, wherein said catalytic activity of said remaining  
structure lacking crystallinity and said substrate component is substantially equal to a  
catalytic activity exhibited by said catalyst material prior to said selective removal of  
crystalline particles.
3. (Original) The method of claim 1, wherein the step of providing said substrate  
component comprises forming said substrate by a gelation/coprecipitation process  
followed by calcining.
4. (Original) The method of claim 1, wherein the step of producing on said surface of said  
substrate component a metallic component comprises applying said metallic component  
by a process selected from precipitation, co-precipitation, gelation, evaporation, a  
deposition-precipitation process, an impregnation process, adsorption of molecules  
followed by decomposition, ion implantation, chemical vapor deposition, and physical  
vapor deposition.
5. (Original) The method of claim 1, wherein said substrate component comprises a  
microcrystalline substance.

6. (Original) The method of claim 1, wherein said substrate component is sintered at a temperature of approximately 400 degrees Centigrade.
7. (Original) The method of claim 1, wherein said substrate component comprises a selected one of a rare-earth-, an alkaline earth-, a Sc- or a Y-doped cerium oxide.
8. (Original) The method of claim 7, wherein said rare-earth is lanthanum.
9. (Original) The method of claim 1, wherein said metallic component comprises an element selected from the group consisting of Au, Pt, Cu, Rh, Pd, Ag, Fe, Mn, Ni, Co, Ru, and Ir.
10. (Original) The method of claim 1, wherein said removal step comprises a process selected from the group consisting of leaching, etching, and dissolving.
11. (Original) The method of claim 1, wherein said removal step comprises leaching with a solution of NaCN.
12. (Previously Presented) The method of claim 11, wherein said removal step comprises leaching with an aqueous solution of 2 mole percent NaCN having a pH of at least 8.
13. (Previously Presented) The method of claim 1, wherein said removal step removes at least 10% of the original quantity of said metallic component.
14. (Previously Presented) The method of claim 1, wherein said removal step removes at least 25% of the original quantity of said metallic component.

15. (Previously Presented) The method of claim 1, wherein said removal step removes at least 50% of the original quantity of said metallic component.
16. (Previously Presented) The method of claim 1, wherein said removal step removes at least 90% of the original quantity of said metallic component.
17. (Original) The method of claim 1, wherein said catalytic activity is exhibited in the performance of a water gas shift reaction.
18. (Previously Presented) The method of claim 1, wherein said substrate comprises an oxide.
19. (Original) The method of claim 1, wherein said substrate comprises a selected one of a zeolite, a carbide, a nitride, a sulfate, and a sulfide.
20. (Original) The method of claim 1, wherein said substrate comprises a crystalline defect solid that provides oxygen to a reaction.
21. (Withdrawn) A catalyst material prepared according to the method of claim 1.
22. (Withdrawn) The catalyst material of claim 21, wherein said metal is selected from the group consisting of Au, Pt, Cu, Rh, Pd, Ag, Fe, Mn, Ni, Co, Ru, and Ir.
23. (Withdrawn) The catalyst material of claim 21, wherein said substrate component comprises a microcrystalline substance.
24. (Withdrawn) The catalyst material of claim 21, wherein said substrate component comprises an oxide.

25. (Withdrawn) The catalyst material of claim 21, wherein said substrate component comprises a selected one of a zeolite, a carbide, a nitride, a sulfate, and a sulfide.
26. (Withdrawn) The catalyst material of claim 21, wherein said metallic component is Au and said substrate component is lanthanum-doped cerium oxide.
27. (Withdrawn) The catalyst material of claim 26, wherein the Au has a concentration in the range of one atomic percent to one one-hundredth of an atomic percent, wherein the atomic percentage is computed according to the expression  
$$\frac{100 \times \text{grams Au}/(\text{atomic mass of Au})}{[\text{grams Au}/(\text{atomic mass of Au}) + \text{grams Ce}/(\text{atomic mass of Ce}) + \text{grams La}/(\text{atomic mass of La})]}$$
, based on a chemical composition of the catalytic material.
28. (Withdrawn) The catalyst material of claim 26, wherein the Au has a concentration in the range of one-half of an atomic percent to one-tenth of an atomic percent, wherein the atomic percentage is computed according to the expression  
$$\frac{100 \times \text{grams Au}/(\text{atomic mass of Au})}{[\text{grams Au}/(\text{atomic mass of Au}) + \text{grams Ce}/(\text{atomic mass of Ce}) + \text{grams La}/(\text{atomic mass of La})]}$$
, based on a chemical composition of the catalytic material.
29. (Withdrawn) The catalyst material of claim 26, wherein the Au has a concentration in the range of 0.44 atomic percent to 0.23 atomic percent, wherein the atomic percentage is computed according to the expression  
$$\frac{100 \times \text{grams Au}/(\text{atomic mass of Au})}{[\text{grams Au}/(\text{atomic mass of Au}) + \text{grams Ce}/(\text{atomic mass of Ce}) + \text{grams La}/(\text{atomic mass of La})]}$$
, based on a chemical composition of the catalytic material.
30. (Withdrawn) The catalyst material of claim 21, wherein said catalyst material is a catalyst for a water shift reaction.



31. (Withdrawn) The catalyst material of claim 21, wherein said catalyst material is a catalyst for a steam reforming reaction.
32. (Withdrawn) A chemical apparatus comprising a catalyst material according to claim 21.
33. (Withdrawn) The apparatus of claim 32, wherein said chemical apparatus is a chemical reactor.
34. (Withdrawn) The apparatus of claim 32, wherein said chemical apparatus is an analytical instrument.
35. (Withdrawn) A method of performing a chemical reaction, comprising the steps of:
  - providing a catalytically effective amount of a catalyst material, said catalyst material comprising:
    - a substrate component having a surface; and
    - adjacent said surface of said substrate, a metallic residue of a metal deposit, said metal deposit comprising a portion having a structure lacking crystallinity and a portion having crystalline particles, said metallic residue comprising at least some of said structure lacking crystallinity and being the remnant of said metal deposit from which at least some of said crystalline particles having dimensions greater than a nanometer have been selectively removed; and
  - exposing said catalyst material to a selected chemical substance under predetermined conditions of temperature and pressure;
  - whereby said selected chemical substance undergoes a catalyzed chemical reaction to produce a product.

36. (Withdrawn) The method of claim 35, wherein said catalyst material comprises a metal selected from the group consisting of Au, Pt, Cu, Rh, Pd, Ag, Ni, Co, and Ir.
37. (Withdrawn) A product prepared according to the method of claim 35.
38. (Withdrawn) A product according to claim 37, wherein said product is hydrogen, and said chemical reaction is a water shift reaction
39. (Withdrawn) A product according to claim 37, wherein said product is hydrogen, and said chemical reaction is a methanol steam reforming reaction.
40. (Withdrawn) A composition of matter, comprising, in combination:  
a substrate component having a surface, said substrate comprising a selected one of an oxide, a carbide, a nitride, and a sulfide; and  
a residue of a metal deposit adjacent said surface, said metal deposit comprising a selected one of Au, Pt, Cu, Rh, Pd, Ag, Ni, Co, and Ir, said residue comprising a non-crystalline metallic substance that remains associated with selective removal of at least some metallic crystalline particles having dimensions greater than a nanometer from said metal deposit;  
whereby said combination comprises a composition of matter having catalytic behavior greater than that of said substrate alone.
41. (Withdrawn) A catalyst material having a substrate and a metallic substance adjacent thereto, comprising:  
a purified form of said catalyst material comprising a non-crystalline metallic substance, said purified catalyst material obtained by selective removal of at least some crystalline particles of said metallic substance;

whereby said catalyst material is freed of metallic crystalline particles having substantially no catalytic activity, while retaining substantially all of the catalytic activity of said catalyst material.

42. (Withdrawn) The catalyst material according to claim 41, wherein said catalytic activity is measured with respect to a rate of reaction per gram of the catalyst material.
43. (Withdrawn) The catalyst material according to claim 41, wherein said catalytic activity is measured with respect to a rate of reaction per unit mass or per unit surface area of the catalyst material..
44. (Withdrawn) An improved catalyst material having a substrate and adjacent thereto a metallic residue of a metal deposit, said metal deposit comprising a portion having a structure lacking crystallinity and a portion having crystalline particles, said metallic residue comprising at least some of said structure lacking crystallinity and being the remnant of said metal deposit from which at least some of said crystalline particles have been removed, wherein the improvement comprises:  
reduction of a metallic content of said improved catalyst material by said selective removal of at least some crystalline particles of said metallic substance, thereby reducing the amount of metal contained in said catalyst material while retaining substantially all of a catalytic activity exhibited by said catalyst material prior to said selective removal of said crystalline particles.

**EVIDENCE APPENDIX**

1. Reference D2, cited by the Examiner in Office Actions dated April 28, 2008 and December 19, 2008, is appended hereto.
2. Reference D3, pages 17-18, 20-22, 39 was cited by the Examiner in Office Actions dated April 28, 2008 and December 19, 2008. Reference D3, pages *xxiii*, *xxiv*, 1-35, and 39, are appended hereto.
3. Reference D4, cited by the Examiner in Office Actions dated April 28, 2008 and December 19, 2008, is appended hereto.

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**RELATED PROCEEDINGS APPENDIX**

None.